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ABSTRACT

This article briefly identifies seven distance education case study projects completed for the Office of Technology Assessment as part of their November 1989 report, "Linking for Learning: A New Course for Education" (ED 310 765). The paper focuses on strengths and weaknesses associated with telecommunicated distance education delivery systems and on current issues related to distance education practice in the United States. Numerous advantages and disadvantages of teaching via satellite are identified, as are advantages and disadvantages of teaching via microcomputer audiographics, and via two-way full motion television. Among some of the current issues identified in distance education delivery are materials transfer, classroom management, remote site visits by teachers, levels of interaction, selection of teachers, technical breakdowns, teacher training, scheduling, class size, and local control. (Author/DB)

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K-12 DISTANCE EDUCATION IN THE UNITED STATES: TECHNOLOGY STRENGTHS, WEAKNESSES, AND ISSUES

Paper Presented at the

1st Annual International Conference on Distance Learning
United States Distance Learning Association

April 10-13, 1991

Washington, D.C.

by

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K-12 DISTANCE EDUCATION IN THE UNITED STATES: TECHNOLOGY STRENGTHS, WEAKNESSES, AND ISSUES

In November 1989, the United States Office of Technology Assessment (OTA) released a national report on distance education entitled *Linking for Learning: A New Course for Education*. Ten contractors worked with OTA project staff to compile data and information for the final report. My contract assignment was to conduct seven case studies of selected distance education programs in the United States. The purpose included looking at the kinds of technology utilized, type of educational audience served, program costs and evaluation, plans for future development, etc. The seven case studies chosen for investigation represented a broad range in terms of project size, differing applications of technology, and geographical location. These included two large interactive satellite TV systems, an urban microwave TV network, two rural audiographics microcomputer networks, one rural two-way fiber optic TV system, and a rural project that combined both microwave TV and audiographics networking. The projects studied are based in Texas, Oklahoma, Washington, North Carolina, New York, Pennsylvania, and Utah.

In this paper, I wish to briefly identify the seven projects/programs investigated for OTA. More importantly, however, the result of having looked closely at seven rather diverse projects has helped me understand some of the inherent strengths, concerns, and issues which I see in the rapidly growing field of telecommunicated distance education as practiced in the Untied States. Hence, the major foci of this paper are: (1) strengths and weaknesses of selected distance education technologies currently in use; and (2) issues related to distance education practice in the United States..

Brief Description of Case Studies Completed for OTA

It is not the intent of this paper to provide a detailed account of the case studies conducted for the OTA. A 380 page report (PB90-125295) documenting the work completed in the case studies is available through the U.S. Department of Commerce, National Technical Information Service (NTIS), Springfield, VA 22161, (703) 487-4650. The cost for the report from NTIS is approximately $40.

Satellite Telecommunicated Educational Program (STEP), Spokane, Washington

The STEP satellite network is a service of the state of Washington's Education Service District 101 in Spokane, Washington. STEP is a national satellite network that presents one-way TV, two-way audio delivery of educational programs to over 100 subscribing schools located chiefly in the northwestern United States. The network has been operative since 1986. STEP was selected as an OTA case study project because of its multi-state focus and the fact that a public agency (ESD 101) has joined with a private company (RXL Communications) to produce and deliver educational programming. Programming is chiefly targeted to rural schools and teachers.

Western Carolina Educational Center, Waynesville, North Carolina

In January 1988, the North Carolina Department of Public Instruction contracted with the TI-IN Network of San Antonio, Texas to install 153 satellite receive dishes in North Carolina. Within the service area of Western Carolina Educational Service Center, 11 small rural schools received satellite dishes to pick up TI-IN's satellite programming which provides one-way TV, two-way audio delivery. The project was selected as an OTA case study because of its regional use of TI-IN, the

nation's largest private, for-profit, vendor of K-12 educational programming.

InterAct Instructional Television Network, Houston, Texas

The InterAct Instructional Television Network is a 50 watt instructional television fixed services (ITFS) network operated by the Region IV Education Service Center in Houston, Texas. It delivers one-way TV, two-way audio instruction to subscribing schools in the Houston metropolitan and Texas Gulf Coast areas. The project was selected as an OTA case study because its clientele is composed chiefly of an urban rather than rural constituency. Also because of its use of Federally licensed FCC ITFS channels as the delivery medium for video as well as talk-back audio.

The Delaware-Chenango BOCES Audiographics Network, Norwich, New York

The Delaware-Chenango Board of Cooperative Educational Services is a pioneer audiographics teleteaching site in upstate New York. The audiographics network is made up of 10 schools joined in a teleteaching project providing distance education via microcomputers and speaker telephones to participating high school students. The project was selected as an OTA case study because of its local focus and its reported low start up and maintenance costs.

The Pennsylvania Teleteaching Project, Shippenville, Pennsylvania

The Pennsylvania Teleteaching Project is the largest statewide audiographics education network in the nation. In 1990, appropriately 50 sites were linked in partnerships of two or three schools joining together to electronically share teachers in some of the state's more remote and isolated schools. The project was selected as an OTA case study because of its statewide focus, reputed low cost, and the ease of the network in forming and dissolving linkages to teach courses on an "as need" basis.

The Panhandle Share-Ed Video Network, Beaver, Oklahoma

The Panhandle Share-Ed Video Network began as linkage of four rural school districts in the Panhandle of Oklahoma which obtained grant monies to lay fiber optics between the four schools to connect TV cameras to form a two-way, full-motion video network. The system was initiated by local superintendents and officials at Panhandle Telephone Cooperative Incorporated. The network formally began offering two-way TV courses between the four schools in the Fall of 1988. The project was selected as an OTA case study because of its use of fiber optics, its small size, its two-way video and audio delivery, and the fact that the entire project was conceived, planned, and initiated locally.

The Northeastern Utah Telelearning Project, Roosevelt, Utah

The Northeastern Utah Telelearning Project began in 1985 and is a cooperative effort of the Northeastern Utah Educational Services Center, seven local school districts, and the region's Area Vocational Center. Technology used in the system includes audiographics, simplex and duplex microwave TV, and UHF TV. The project was selected as an OTA case study because of its multiple, yet compatible use of a variety of distance learning media.

Strengths and Weaknesses of Distance Learning Technologies

Much has been written about the benefits of distance education technologies as tools to provide educational equity to audiences in remote or geographically isolated settings. And, it is true that today's technologies are providing increased learning opportunities for all types of learners -- opportunities which might otherwise be denied. Today's technologies -- those that allow for live delivery of instruction from one site to another with audio and/or video interaction between teachers and students -- have been accepted so rapidly, however, that few questions relative to program quality, technological limitations, or student performance have been asked. The U.S. Congress's $100 million dollar funding for Star Schools projects over the next several years is evidence of how quickly political leaders at the national level have accepted distance learning technologies as viable tools to reach isolated students. Distance learning's growth and its initial acceptance is exciting, but we also need to pause and reflect that the technologies themselves are no panacea.

The capabilities of the technologies differ; in some cases significantly. There are definite advantages and there are disadvantages associated with each technology currently being used. In the same respect, there are differences in program practices between vendors using the same or similar technologies. Some of the advantages and disadvantages of three of the more popular technologies -- satellite delivery, audiographics delivery, and two-way full-motion TV delivery (via fiber optics, microwave, low power UHF, or cable) are listed in the following section. The lists have been compiled from the perspective of K-12 instruction. They are intended to provoke thought and are by no means exhaustive.

Advantages of Satellite TV Teaching

1. Students can see the teacher.
2. Full-motion video exists.
3. Teacher/student audio interaction is possible.
4. Real-time print distribution of handout material is possible with most systems. That is, the teacher at the host site can activate a printer at the respective remote sites to send handouts, tests, etc.
5. Satellite signals are distance insensitive -- large geographical areas and many remote sites can be covered simultaneously helping to reduce costs by sharing them among a large number of users. The larger the system, the lower the transmission cost.
6. Most satellite systems are "turn-key" operations. Program offerings, scheduling, instruction, grading of students, distribution of materials, etc. are provided by the satellite vendor.
7. Satellite programming is the most widely known distance learning technology. Because of its notoriety, it is often easier to get local boards and decision makers to release funds to implement distance learning. Satellite programs also have a good track record for receiving federal and state funds.

Disadvantages of Satellite TV Teaching

1. Program offerings are centralized, thereby limiting control by local districts. This may result in loss of local control of teaching and interpretation of the curriculum by local education units.
2. The TV teacher cannot see the students. Satellite technology incorporates one-way video, two-way audio (via phone connection) between students and teacher.
3. Students at receive sites are unable to see their counterparts (other students) at other receive site locations. Nor are they able, in most cases, to freely interact via audio with their counterparts.
4. Telephone contact during class is not immediate. Unless previously on-line with the

classroom studio (which prevents other sites from initiating calls to the teacher), students must dial the studio and await response from the teacher. This "hassle" prevents some students from calling in. It is not unusual for students to initiate a call and find that the line is busy with other students (at different sites) also calling in.

5. An audio "echo" is often inherent in student talk-back through the TV system when telephoning to interact with the TV teacher. Interference from florescent lights in some receive site classrooms can also cause "noise" during the audio connection by telephone.
6. Some receive dishes (Ku band) are weather sensitive -- during heavy rains or snows, the signal can be lost. Signal interruption can also result from both Ku and C band reception during periods of "sun outages." This occurs intermittently for a few minutes over several days every six months when the orbiting satellites TV transmitted signals are aligned directly with the sun.
7. The potential exists for large class size. It is not unusual to have a class with 200 to 300 students. Some vendors currently offering satellite courses have classes with as many as 1000 students. Large class size severely limits opportunities for teacher-student interaction. Furthermore, most rural schools cherish a tradition of small classes.
8. Student -to-student interaction at different sites is extremely limited at best, or non-existent at worst. The technology does not allow students to see each other at different sites. They can only hear or interact with each other if more than one site is connected at the same time via telephone with the classroom studio. Most systems have a limited number of telephones (4-6) that can be "tied in" with the classroom studio simultaneously. In terms of interaction, the technology chiefly promotes teacher-student interaction, not student-to-student interaction between sites.
9. Large satellite systems that broadcast throughout the United States can promote the creation of a "national curriculum." Virtually all satellite vendors broadcast courses to students across state boundaries. Control of the TV teacher and the curriculum content by the local school district is minimal.
10. In addition to start-up costs for a satellite dish and other appropriate receive equipment, the school must pay an annual subscription fee (often several thousand dollars) to the satellite vendor every year in order to receive continued programming.
11. Bell scheduling conflicts, time zone differences, differences in dates for scheduling spring breaks, holidays , etc., often conflict with local school schedules and are not easily resolved.

Audiographic Teleteaching/Microcomputer Teleteaching Advantages

1. Local schools maintain control of the master teacher, programming, and scheduling. Because the network is typically small and locally controlled changes in selection of a teacher, programming offerings, scheduling, etc. can easily be changed.
2. Small class size is guaranteed. This type of technology does not permit linkage with more than a few sites simultaneously. Some microwave TV distance learning systems have 60+ sites while some satellite TV distance learning systems have over 1000 students in multiple sites being taught simultaneously. Meaningful teacher-student exchanges with such large classes, compounded by the fact that the instruction is delivered via distance technologies, makes high levels of interaction between teacher and students highly unlikely.
3. The system supports student/to/student interaction between sites in addition to teacher/student interaction. The speaker telephones act much like an "open" microphone. Once the classes are connected, students in one locations can speak at-will to their teacher or to other students in another location. Telephone talk-back or interaction by students does not need to be re-initiated each time a student wishes to ask a question or to make a comment.

4. Low cost in terms of hardware, software, and maintenance. Start up costs for an individual school to participate fully in an audiographics cooperative network need not exceed $5000 to $6000. There is usually no annual subscription fee for courses as is typical for most satellite and/or microwave TV distance learning courses. One time start-up costs for audiographics software vary between current vendors, ranging between $1300 - $4000 per site. The on-going operation costs are usually limited to the monthly telephone charges and toll charges for linkages between sites where long distance toll charges are incurred.
5. Relatively simple to learn and to operate. Learning to use and operate an audiographics teleteaching system does not require extensive technical knowledge or training on the part of the user. Most teachers who know how to use a microcomputer for word processing can quickly learn the skills and technique necessary to successfully operate an audiographics system.
6. Any participating site can serve in either a "receive" or a "transmit" mode. Hence, instruction can emit from any participating site. Therefore, each school on the network can offer courses electronically as well as receive instruction.
7. The computer generated visuals can be activated and accessed by the teacher as well as any student at any remote site. Instruction on the system or control of the system can be alternately switched from one site to another in a matter of 1-2 seconds. This allows for high levels of interaction between teacher and students.
8. Instructional content is focused more on the organization of the material than on the personality of the teacher. Students at distant sites do not see the teacher. A common visual reference is shared on the computer screen and students and teachers freely interact orally via the speaker telephone. Hence, the charisma or personality of the teacher seems to be less of a factor in learning than is the content.
9. Operates over regular telephone lines. Therefore, linkages between distant sites can easily be made almost anywhere in the world.

Audiographic Teleteaching/Microcomputer Teleteaching Disadvantages

1. Motion is not possible. Display of visuals on the computer screen is in a still picture or freeze-frame mode.
2. The instructor cannot see the student, nor can students see the instructor or other students at distant sites. The teacher and students at each site all share a common computer generated graphic on their respective computer screen, but they do not see each other.
3. Loss of transmission connection. Extraneous noise or interference on the telephone lines can cause voice transmission on the speaker telephones to occasionally "break up" resulting in a loss of transmission or disconnection.
4. The video graphics/image displayed between computer monitors is limited to the size of the computer screen unless additional hardware is added. Additional hardware may include a large TV monitor (eg. 25 inch) or use of an LCD type projector joined with an overhead projector to enlarge the computer image on a big screen.
5. Lesson planning (creating of computer visuals) can be considerably time consuming for the teacher. In addition, floppy disks which are used to store the slides created for each lesson must be distributed to all remote sites and loaded into networked computers prior to transmission or a lesson.
6. Transmission costs for telephone toll charges can become excessive. Most current audiographic networks operate on two separate telephone lines. One for computer connection and one for speaker phone connection. Unless distance sites have access to WATTS lines or other lower cost carriers, telephone toll costs can become burdensome.
7. Audiographics is not a "turn-key" operation. Management of a computer teleteaching network requires a commitment by local school administrators in terms of human

resource time to train teachers to instruct over the system and to prepare slides and lessons for delivery over the system. Many satellite and microwave TV systems are administered in a distant location which is away from the local school thereby requiring limited or no local administrative monitoring.

Two-way TV Instruction (Fiber Optics, some Microwave or Cable Systems) Advantages

1. Two-way, full-motion video is possible between all sites. Students can see the teacher as well as see and hear other students at all sites. The teacher can see and hear all students at all sites.
2. Most systems presently in operation are small networks that promote local control of the teacher and the curriculum, and overall maintain small class size.
3. Open-line microphones allow for full teacher-student and student-to-student interaction. That is, students can interact audibly not only with the TV teacher but also with students at other sites. Furthermore, audio interaction is immediate; no telephone dialing is required because open-line microphones are used for the audio.
4. Most TV signals via mediums currently used are unaffected by weather.
5. Any site on the network can serve as the "host" classroom. There is <u>not</u> a designated studio/classroom. Therefore, instruction can originate from any participating site negating the need for the TV teacher to always be at just one location. He/she can travel and broadcast between sites.
6. Unless required by state law, the presence of an adult or classroom facilitator at remote sites is typically not necessary.

Two-way TV Instruction (Fiber Optics, some Microwave or Cable Systems) Disadvantages

1. Cable (to be used as an extra broadcast channel) in many rural areas is still not available.
2. Fiber optics, although becoming more available, is still not accessible for telecommunications is many rural communities; also, it is very expensive to lay and install.
3. Virtually all successful two-way interactive TV systems are based around a partnership arrangement between the local school and business or industry officials in the area. Many rural communities do not have the "required" pool of human resources necessary to form a meaningful business/school partnership.
4. Most systems require a large amount of capital investment to pay for start-up costs.
5. Does not lend itself well to extremely large networks. If you link more than about 10 sites together, it becomes costly and cumbersome to maintain two-way "visibility" with each receive site location.

Issues Related to Distance Education Practice

Successful use of distance education technologies demands that certain issues be addressed. Those listed below seem to be common among most projects. The manner in which each is addressed, however, frequently varies between vendors/providers and/or the type(s) of technology used.

Materials transfer: Each distance education project must establish an efficient and reliable system to exchange materials between participating sites. Tests, quizzes, assignments, textbooks, and other materials may be transported by postal service, teachers who live in one district but teach in another, facsimile machines, electronic mail, etc.

Classroom management: A single policy for dealing with students in distance

education courses should be established and enforced. A consistent procedure for dealing with student discipline is vital to the success of a distance education program.

Remote site visits by teacher: Students at remote classrooms should have the opportunity to periodically meet their teacher "in the flesh" and become personally acquainted. The same is true for getting acquainted with other students at different sites.

Levels of interaction: Are students able to interact only with their distance education teacher or can they also interact freely during the class with other students at different sites? Technologies that permit interaction only between teacher and student are much more limiting instructionally than those that permit both teacher-student and student-to-student interaction.

Selection of teachers for distance education delivery: Distance education teachers of necessity must be "master" teachers. This implies not only that they understand and model principles from the literature on "effective teaching," but that they also know how to best use the respective telecommunications medium to convey their teaching. For example, we can learn much from the field of mass communications (eg. commercial radio and television) in regards to how to present information via the airwaves. This is not to imply that distance learning teachers need to act like Johnny Carson when they teach a course, but they must possess a "presence" that capitalizes on the use of the medium they are teaching over. Furthermore, teaching pedagogy -- as related to distance education -- requires forced interaction between teacher and students, a slower pace of instruction, and clear logical presentations. The teacher needs to ask a lot of questions to ascertain whether or not students understand, because in most systems the teacher cannot see students and is therefore unable to respond to nonverbal cues.

Technical breakdown: There will be "down time" with any system. Those who drive a car know that technology doesn't always work. Who is going to fix things when they break down? Maintenance agreements with vendors and contractors are important factors for policy makers to consider when forming a cooperative or entering into an agreement with a large distance education vendor.

Teacher training: Some training of the distance education teacher(s) is essential. Regardless of how exotic or exciting the technology, it will never be a substitute for poor instruction. Ultimately, the significance of the content presented and the quality of instruction will be much more important than the technology used to convey the message. Effective training of the distance learning teacher(s) and classroom facilitators is vital for program success.

Scheduling: One of the biggest problems with large distance education programs is the matter of bell scheduling. This becomes compounded when programs are broadcast over different time zones. The matter is not easily resolved because a school district's bell schedule is dependent upon bus routes, lunch schedules, elementary, middle school, and high school schedules, local holidays, and school assemblies. A related problem is scheduling of local school start and ending dates, parent teacher conferences, state mandated teacher inservice and preparation days that close classes, and differences in Spring breaks and Christmas vacations. Furthermore, some schools operate on a 9 week grading period while others are on 6, 12, and 18 weeks student evaluation periods. Such variations present serious challenges to large distance education providers (chiefly satellite systems) broadcasting to many receive sites in multiple states and across different time zones.

The "personal touch": There must be an effort to personalize instruction between the

teacher and student regardless of the distances involved. Students at remote sites must feel a sense of belonging to the host site classroom. The teacher should call students by name, look directly into the camera (if the instruction involves TV delivery) as though he/she is looking at the.n. The telephone adage to "reach out and touch someone" definitely has meaning when delivering distance education course work.

Local control: Many rural school districts fiercely protect local control of their curricula, teaching, and scheduling. Most often, they do not want outside "experts" dictating what classes will be taught and when. Local educators should have a choice of options when selecting a distance education alternative. For example, if a school selects one of the present satellite vendors, a steerable dish with both a Ku and C band feedhorn would be the ideal receive dish. This would allow the school the opportunity to take classes from a selection of vendors and not be "locked in" to just one provider. The school would thereby have, at least to an extent, greater control in terms of program selection and scheduling.

Class size: Overall class size will have a direct impact on opportunities for student interaction and participation. Small, locally controlled cooperatives usually limit class size and thereby help ensure meaningful contact between the teacher and students. Systems that have a national focus (eg. satellite providers) may easily have 200+ students enrolled in a class with very limited opportunities for interaction during the class broadcast. In such cases, the program provider should have in place a student support system designed so that individual students do not "get lost in the cracks." Specified office hours when students can call the satellite teacher, or telephone contact initiated from the satellite central office during "off air" hours to individual schools, will help students feel that they are "known" by the teacher and are indeed a part of the class. Some satellite vendors (eg. Star Channels, Kentucky Educational Television) have upgraded their technology so that students at remote sites have small response pads which operate somewhat like a hand held calculator. When the teacher asks a question, students at remote sites can punch a button or series of buttons on the response pad. The TV teacher receives immediate feedback as to whether students understand the question posed. Incorporation of such technology into a large network can effectively promote student participation in big classes as well as provide the teacher with feedback as to how well students understand.

Conclusion

This paper has briefly listed distance learning projects that were closely investigated as a part of the U.S. Office of Technology Assessment's recent study on distance learning. The chief foci of this paper, however, has been on (1) identifying the major advantages and disadvantages of selected telecommunications technologies used for distance learning and (2) listing some of the practical issues facing distance education users and providers.

Improvements in telecommunications have made it increasingly easy to transmit instructionally useful images and sound over geographically forbidding distances. The growth and interest in distance learning technologies and programs is moving at a rapid rate. It is expected that existing networks will expand and new projects will be established. Current practice clearly demonstrates that successful programs are varied. Differing types of technologies and varied practices are being successfully employed. There does not appear to be *one* best method or approach for distance learning. Some programs/systems now in use are very expenses; other are surprisingly low in cost -- yet, positive results are being reported from a broad array of distance education users. Distance learning technologies and programs are reaching out to diverse audiences providing increased opportunities for educational growth and advancement.